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Regional Science and Urban Economics 32 (2002) 651–671

regional SCIENCE & urban ECONOMICS

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Spatial-network, general-equilibrium model with a stylized application

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Received 12 January 1999; accepted 24 September 2001

Abstract

Spatial aspects of economic policy are often important. However, multi-region computable general equilibrium (CGE) models have rarely explicitly treated geographical space. This paper develops a spatial-network, mixed-complementarity CGE model, incorporating formulations from partial-equilibrium programming models. We implement the model with a prototype data set for a stylized, poor, developing country with rural regions linked to an urban region that is linked to international markets. We demonstrate that the model provides a good framework for analyzing the impact of higher world prices and reduced domestic transportation costs and that the explicit incorporation of space has a strong impact on simulation results.

Keywords: Computable general equilibrium; CGE; Spatial network; Multi-region modeling; Transportation costs; Trade policy

JEL classification: C68; D58; R13; 018

1. Introduction

Consideration of the spatial impact of economic policy is of critical importance to policy makers. In recent years, the relevance of space has been underlined by a

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0166-0462/02/$ – see front matter
PII: S0166-0462(01)00099-0

surge in regional strife in nation states throughout the world. The need for spatial disaggregation is underlined by empirical findings which suggest that the regional effects of changes in policies and exogenous shocks may be significantly different from the national average (Nijkamp et al., 1986, pp. 259 and 261; Miller and Blair, 1985, p. 63). At the same time, models of a single region inside a country, for which the national economy is assumed to be given, may generate misleading results since they do not allow for inter-regional and nation-region feedbacks. In this environment, spatially disaggregated national models are often the preferred tool for policy analysis.

In recent years, many countries have undergone changes in trade and exchange rate policies. Policy shifts in these areas may have very different effects across regions due to regional differences in economic structure and the existence of high transportation and communications costs. When, as a result, market links across regions are weak, the 'national' economy may be better seen as a collection of imperfectly linked regional economies. In this environment, changes in national policy may have little effect on some regions when the changes in prices are too small to induce changes in regional trade. There will also be 'threshold effects' whereby changes in, say, trade policy will have little or no effect until the changes are large enough to cause regional producers and consumers to react to changes in prices external to the region, generating sectoral trade flows where before particular regional markets were autarkic.

The multi-region modeling literature includes both partial- and general-equilibrium approaches. In the partial-equilibrium, programming tradition, the typical formulation permits the model to endogenously select the quantities traded, including the regime for each tradable commodity and regional link. This link may be inactive or may ship in one of the two directions, but not both.[1] This approach assumes that tradable commodities are homogeneous or perfectly substitutable irrespective of source (from the perspective of the demander) or destination (from the perspective of the supplier).

In the general-equilibrium literature, which encompasses economywide input–output models and computable general equilibrium (CGE) models, available multi-region models rarely consider space explicitly.[2] Most models assume product

[1] Seminal papers in this literature are Samuelson (1952) and Takayama and Judge (1964). For a more recent survey, see Thore (1991).

[2] For surveys, see Nijkamp et al. (1986), Partridge and Rickman (1997), and Isard et al. (1997). The seminal multi-regional input–output model is in Isard (1951). The few CGE models that explicitly consider space include Buckley (1992), Wigle (1992), Roson (1995), and Elbers (1995). Elbers' paper, which is discussed in footnote 5, is further distinguished by modeling a mix of spatially heterogeneous and homogeneous commodities, with regime shifts in trade for the latter.